

## EXTRACTION SYSTEMS FOR THE STUDY OF DUBNIUM

J.M. Gates<sup>1,2</sup>, R. Sudowe<sup>2,3</sup>, M.N. Ali<sup>1</sup>, M.G. Calvert<sup>1,2</sup>, I. Dragojevic<sup>1,2</sup>, P.A. Ellison<sup>1,2</sup>,  
M.A. Garcia<sup>1,2</sup>, N. Gharibyan<sup>1</sup>, K.E. Gregorich<sup>2</sup>, S.L. Nelson<sup>1,2</sup>, S.H. Neumann<sup>4</sup>,  
T. Parsons-Moss<sup>2</sup>, L. Stavsetra<sup>2</sup>, and H. Nitsche<sup>1,2</sup>

<sup>1</sup>*Department of Chemistry, University of California, Berkeley, CA 94720, USA,* <sup>2</sup>*Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA,*

<sup>3</sup>*Department of Health Physics, University of Nevada, Las Vegas, NV, 89154, USA,*

<sup>4</sup>*Department of Applied Sciences and Technology, Aachen University of Applied Sciences, D-52428 Juelich, Germany*

The study of the chemistry of transactinide elements ( $Z \geq 104$ ) is a topic of great interest of current nuclear chemistry research. The chemical systems that can be used to study these elements are limited by their short half-lives and the small production rates of atoms per minute or even atoms per week. Until recently, the chemistry used had to separate the element of interest from all the other unwanted nuclear reaction products, e.g. transfer products. Using the Berkeley Gas-filled Separator as a physical preseparator allows us to concentrate on systems that are selective between the members of the group of interest, because all other interfering products and the beam are being suppressed by the BGS. We are developing suitable extraction systems for the study of element 105, dubnium. For this purpose we have studied the extraction of niobium and tantalum, the lighter homologs of dubnium, with different organophosphorous compounds from mineral acids.

We have focused on the use of two organophosphorous compounds: Di-2-ethylhexyl hydrogen phosphate (HDEHP) and di-2-ethylhexyl hydrogen phosphate (BEHP). By varying the concentration of the mineral acid, hydrogen ion or complexing agent, it is possible to follow the growth of ionic species for the lighter homologues. At low metal concentrations used in our studies ( $\sim 10^{-16}$  M), the chemistry of the group V elements is not affected by formation of polymers. This leads to behavior that is different than what is seen in macroscopic systems. In our studies, niobium and tantalum show different chemical behavior at high hydrochloric acid (HCl) concentrations and low hydrogen ion/high chloride ion concentrations when extracted by HDEHP and the BEHP. In addition, extraction studies show that tantalum continues to form extractable cationic or neutral complexes at HCl concentrations above 9 M, where the formation of anionic species should be favored. Further work is being performed to understand the formation of species and the role of the complexing agent and hydrogen ion concentration in the extraction of the homologues.

This work was supported by the Director, Office of Science, Office of High Energy and Nuclear Physics, Division of Nuclear Physics, US Department of Energy under Contract No. DE-AC02-05CH11231.